

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference WBH.M13	FOR FURTHER ACTION see Form PCT/ISA/220 as well as, where applicable, item 5 below.	
International application No. PCT/GB2004/001471	International filing date (day/month/year) 02/04/2004	(Earliest) Priority Date (day/month/year) 03/04/2003
Applicant MICROEMISSIVE DISPLAYS LIMITED		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 4 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ The international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. ☐ **Certain claims were found unsearchable** (See Box II).

3. ☐ **Unity of invention is lacking** (see Box III).

4. With regard to the title,

☐ the text is approved as submitted by the applicant.

☒ the text has been established by this Authority to read as follows:

ION BEAM METHOD FOR REMOVING AN ORGANIC LIGHT EMITTING MATERIAL

5. With regard to the abstract,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regards to the drawings,

- a. the figure of the **drawings** to be published with the abstract is Figure No. 1

☒ as suggested by the applicant.

☐ as selected by this Authority, because the applicant failed to suggest a figure.

☐ as selected by this Authority, because this figure better characterizes the invention.

- b. ☐ none of the figures is to be published with the abstract.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB2004/001471

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H01L51/56 H01L51/40

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 98/21755 A (GRAHAM TERESITA ORDONEZ ; LIEN SHUI CHIH ALAN (US); IBM (US); ANGELOPO) 22 May 1998 (1998-05-22) page 2, paragraph 3 page 20, paragraph 2 page 21 page 31, paragraph 4 - page 32, paragraph 1 page 33, paragraph 2 - page 35; figures 18,19 page 36, paragraph 3 page 37, paragraph 2 - page 38, paragraph 1; claims 88,91,93,98,119-121; figures 22,23	1,2,4,9, 11,12
Y	----- -/--	2,3,5-8, 10,12

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- *Z* document member of the same patent family

Date of the actual completion of the international search

27 July 2004

Date of mailing of the international search report

02/08/2004

Name and mailing address of the ISA

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Authorized officer

Klopfenstein, P

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 1999, no. 08, 30 June 1999 (1999-06-30) -& JP 11 074084 A (TORAY IND INC), 16 March 1999 (1999-03-16) abstract paragraph '0005! - paragraph '0006! paragraph '0009! - paragraph '0011!	1,2,4,9, 11
Y	-----	3,5-8, 10,12
X	US 5 953 585 A (MIYAGUCHI SATOSHI) 14 September 1999 (1999-09-14) column 1, line 5 - line 17 column 1, line 42 - line 54 column 1, line 55 - column 2, line 22 column 2, line 61 - column 3, line 62; figures 1a-1d	1,4,9,11
Y	-----	2,3,5-8, 10,12
Y	PATENT ABSTRACTS OF JAPAN vol. 2000, no. 10, 17 November 2000 (2000-11-17) -& JP 2000 192224 A (ROHM CO LTD), 11 July 2000 (2000-07-11) abstract paragraph '0006! - paragraph '0013!; figures 13a-13d paragraph '0015! - paragraph '0016! paragraph '0029! - paragraph '0031!; figures 1a,6c paragraph '0054! - paragraph '0057!; figures 6a-6c	3
Y	-----	3
Y	PATENT ABSTRACTS OF JAPAN vol. 1999, no. 11, 30 September 1999 (1999-09-30) -& JP 11 167987 A (NEC CORP), 22 June 1999 (1999-06-22) abstract paragraph '0006! paragraph '0009! - paragraph '0011!; figures 3,4,7	5,6
Y	-----	7,8
Y	PATENT ABSTRACTS OF JAPAN vol. 0091, no. 57 (P-369), 2 July 1985 (1985-07-02) -& JP 60 033501 A (KOGYO GIJUTSUIN; others: OJ), 20 February 1985 (1985-02-20) abstract	
Y	-----	
Y	US 4 233 109 A (NISHIZAWA JUNICHI) 11 November 1980 (1980-11-11) column 1, line 11 - line 43 column 3, line 3 - line 42	

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB2004/001471

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO 9821755	A	22-05-1998	EP 0953213 A2	03-11-1999
			JP 2000505249 T	25-04-2000
			TW 557386 B	11-10-2003
			WO 9821755 A2	22-05-1998
			US 6331356 B1	18-12-2001
JP 11074084	A	16-03-1999	NONE	
US 5953585	A	14-09-1999	JP 9293589 A	11-11-1997
JP 2000192224	A	11-07-2000	NONE	
JP 11167987	A	22-06-1999	JP 2848384 B2	20-01-1999
JP 60033501	A	20-02-1985	NONE	
US 4233109	A	11-11-1980	JP 1231795 C	26-09-1984
			JP 52088238 A	23-07-1977
			JP 59004506 B	30-01-1984
			JP 1121861 C	12-11-1982
			JP 53028377 A	16-03-1978
			JP 57003213 B	20-01-1982
			JP 1121862 C	12-11-1982
			JP 53028378 A	16-03-1978
			JP 57003214 B	20-01-1982
			US 4371412 A	01-02-1983

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:

see form PCT/ISA/220

PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY (PCT Rule 43bis.1)

Date of mailing
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference
see form PCT/ISA/220

FOR FURTHER ACTION
See paragraph 2 below

International application No.
PCT/GB2004/001471

International filing date (day/month/year)
02.04.2004

Priority date (day/month/year)
03.04.2003

International Patent Classification (IPC) or both national classification and IPC
H01L51/56, H01L51/40

Applicant
MICROEMISSIVE DISPLAYS LIMITED

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☒ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA"). However, this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of three months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA:



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**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**International application No.
PCT/GB2004/001471

Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.
☐ This opinion has been established on the basis of a translation from the original language into the following language , which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).
2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:
 - a. type of material:
☐ a sequence listing
☐ table(s) related to the sequence listing
 - b. format of material:
☐ in written format
☐ in computer readable form
 - c. time of filing/furnishing:
☐ contained in the international application as filed.
☐ filed together with the international application in computer readable form.
☐ furnished subsequently to this Authority for the purposes of search.
3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
4. Additional comments:

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.
PCT/GB2004/001471

Box No. II Priority

1. ☒ The following document has not been furnished:

☒ copy of the earlier application whose priority has been claimed (Rule 43*bis*.1 and 66.7(a)).

☐ translation of the earlier application whose priority has been claimed (Rule 43*bis*.1 and 66.7(b)).

Consequently it has not been possible to consider the validity of the priority claim. This opinion has nevertheless been established on the assumption that the relevant date is the claimed priority date.

2. ☐ This opinion has been established as if no priority had been claimed due to the fact that the priority claim has been found invalid (Rules 43*bis*.1 and 64.1). Thus for the purposes of this opinion, the international filing date indicated above is considered to be the relevant date.

3. Additional observations, if necessary:

Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	3 5-8 10
	No: Claims	1 2 4 9 11 12
Inventive step (IS)	Yes: Claims	1 2 4 9 11 12
	No: Claims	3 5-8 10
Industrial applicability (IA)	Yes: Claims	1-12
	No: Claims	

2. Citations and explanations

see separate sheet

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING
AUTHORITY (SEPARATE SHEET)**

PCT/GB2004/001471

Re Item I**Basis of the opinion**

The examination is being carried out on following application documents:

Description:

Pages 1-5 as originally filed

Claims

Claims 1-12 as originally filed

Figures Drawings

Sheet 1/1 as originally filed

Re Item V

Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Reference is made to the following documents:

D1 : WO-A-98/21755

D2 : PATENT ABSTRACTS OF JAPAN & JP-A-11074084

D3 : US-A-5953585

D4 : PATENT ABSTRACTS OF JAPAN & JP-A-2000192224

D5 : PATENT ABSTRACTS OF JAPAN & JP-A-11167987

D6 : PATENT ABSTRACTS OF JAPAN & JP-A-60033501

D7 : US-A-4233109

V.1 Lack of novelty

The present application does not meet the requirements of the PCT because the subject-matter of **claims 1, 2, 4, 9, 11, 12** is not new in the sense of Article 33(2) PCT.

- V.1.1 The document **D1** is regarded as being the closest prior art to the subject-matter of **claim 1** and shows (cf. page 2, paragraph 3; page 20, paragraph 2; page 21; page 31, paragraph 4; page 37, paragraph 2 and Fig.22) the fabrication of an organic light emitting device (OLED or diodes), comprising a method of removing an organic light emitting material (ie an electrically conducting polymer, see from page 34, third para- graph to page 35, second paragraph) from defined areas of a substrate (ie from

organic light emitting diode pixels), comprising the steps of arranging a shadow mask (see the metal mask in Fig.22.2) to overlie the organic material other than in the defined areas, and applying a beam of ions to the defined areas through the mask openings, thereby anticipating a method according to **claims 1, 2, 9, 11, 12**. In D1, the ions are chemically reactive with the substrate, see last paragraph of page 37 (features of **claim 4**).

Thus, document D1 anticipates a method according to **claims 1, 2, 4, 9, 11, 12**.

V.1.2 Also **D2** (cf. abstract, Fig.1, formulae 1-4 and items [9]-[11] and [26], [27]) discloses a method anticipating the features of **claims 1, 2, 4, 9, 11** (see light emitting layer (3) and shadow mask (5)) and **D3** shows in col.1, 42-54; col.2, line 61 to col.3, line 62 and Figs.1A-D a method according to **claims 1, 4, 9, 11**, see light emitting layer (3) and shadow mask (5) (when assessing the relevance of D3, a "shadow mask" was defined as any masking material able to shadow/protect the substrate from the etching ions).

V.2 Lack of inventive step

Dependent **claims 3, 5-8, 10** do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of inventive step in the sense of Article 33(3) PCT.

V.2.1 The problem to be solved by the features of **claim 3** may be regarded as the occurrence of damages to the light-emitting material, in case of a direct contact with the shadow mask (see also description page 2, lines 1-4).

Once having identified the problem, the solution of avoiding or minimizing any direct contact between the shadow mask and the light-emitting layer becomes obvious. Such a contact is minimized either by disposing the mask over the device to be etched (no contact at all) or using a mask with as small as possible contact portions. Moreover, this problem and the two alternative solutions of **claim 3** are well known in the art, see **D4** (see Figs.1A and 6C) showing the use of a shadow mask (2) with recesses (2b) located at the portions of the light emitting material (R) defining the pixels (like in the application in page 3, lines 16-20) and document **D5** (see Figs.1c, 3) where a substrate (1) has recesses (5) formed in order to avoid contact between the shadow mask (8) and the light emitting layer (7) at the anode portions (active portions). In both documents, a contact between mask and light emitting layer is explicitly to be avoided or minimized for the purpose of protecting the light emitting layer (using such a shadow mask as a deposition or as an etching mask is irrelevant

in view of the above problem).

As the features of claim 3 are described in documents **D4** and **D5** as providing the same advantages as in the present application, it would be obvious to the person skilled in the art, namely when the same result is to be achieved, to apply these features with corresponding effect to the etching steps described in any of documents **D1** to **D3** in order to solve the problem posed.

V.2.2 Organic light emitting material can also be usually removed by ion beam etching using inert gas ions, such as Argon, see **D6**, so that the features of **claims 5, 6** merely represent a customary alternative to the use of chemically reactive ions of **D1**, coming within the scope of the customary practice followed by persons skilled in the art.

As the document **D1** does not detail the processing parameters of the ion beam etching (IBE) step, the skilled person will look in the art of IBE, which parameters have an influence on the efficiency and precision of IBE and will find from **D7** (cf. col.1, lines 10 to 44 and col.4, lines 3-42) that, as a general principle in any etching method using ion bombardment (ion etching or plasma etching), in order to improve the etching precision, it is preferred to process at high vacuum (pressures of 10^{-4} Torr or even higher vacuum, see col.4, lines 15-23) which leads to an increase of the mean free path of the ions and a reduction of collisions between particles, thus improving the directionality and accuracy of the etching of the light emitting polymer layer of **D1**.

Thus, the features of **claims 7, 8** are usual in ion etching and would be selected by the skilled person in **D1** aiming to carry out highly minute patterning.

The etched organic material in **D1** is formed of an organic layer of an array of organic light emitting diodes, said ion beam removal step could obviously be applied to any exposed portion of said layer, such as for example from bond pad regions, according to **claim 10**. More specifically, these bond pads are located in the application between the pixels (see Fig.1), which is also the location at which the light emitting material is removed in documents **D1**, **D2** and **D3**.

V.2.3 The reasoning and comments of items V.2.1 and V.2.2 reasoning also apply, mutatis mutandis, to the subject-matter of the corresponding dependent claims, in the light of prior art **D2** and **D3** which therefore are also considered as not involving an inventive step.